Resource Action: EWG-104 **Task Force Recommendation Category:** 2

Increase Connectivity of the Lower Feather River to Floodplain Habitats

Date of Field Evaluation: No field evaluation has been conducted.

Evaluation Team: Richard Harris, Koll Buer, and Bruce Ross

Description of Potential Resource Action Measure:
This measure proposes to increase connectivity between the river channel and adjacent floodplain habitats (including low-elevation terraces) in the Feather River below Thermalito. Improved connectivity would be achieved in one or more of the following ways: 1) physical modification of geomorphic surfaces (e.g., reducing floodplain elevations); 2) levee setbacks (e.g., improve access of the river to its floodplain); and/or 3) increasing the magnitude and/or duration of streamflow. This Resource Action replaces EWG-21, EWG-22, EWG-23, EWG-24 and EWG-25.

The following resource actions are directly related to the proposed measure:

- Streamflow Modifications: EWG-4A, EWG-4B (pulsed attraction flows), EWG-100, others aimed at temperature management
- Habitat Enhancement:
    - Rearing and Spawning Habitat: EWG-13A/20
    - Side Channels: EWG-99
    - Channel and Floodplain Modifications: EWG-19A, EWG-93B
    - Riparian Vegetation: EWG-66, EWG-78B (flow regime)

Nexus to Project:
The Oroville project, in conjunction with the existing flood control levee system, has directly contributed to a reduction in the quality and quantity of instream and riparian habitat in the lower Feather River since 1968. Causal mechanisms for this include the trapping of sediment behind the dam, reduced frequency and magnitude of peak flow events and increased summertime flows. In addition to contributing to downstream habitat degradation, the construction of Lake Oroville eliminated potential access to upstream habitat for anadromous salmonids.

Potential Environmental Benefits:
The benefits of increasing connectivity between the river and its floodplain could include improvements in the quality and quantity of fish habitats (i.e., spawning and rearing for splittail and rearing for salmonids) and increased availability of land for recruitment and development of riparian vegetation. Improved riparian vegetation conditions would in turn provide a source of materials for in-stream large woody debris and benefit wildlife that use riparian habitats.

Potential Constraints:
Constraints to implementing this measure would depend on the specific approach taken to improve connectivity of the stream to its floodplain at specific locations. Physical modification of geomorphic surfaces would entail work in and near the channel. This would likely be subject to permitting requirements of the US Army Corps of Engineers, Department of Fish and Game, NOAA-Fisheries, US Fish and Wildlife Service and State or Regional Water Quality Control Board. It would also require at least some engineering design and modeling to determine the proper configuration for the modified surface(s). Levee setbacks potentially would require either willingness by landowners and/or land purchase or must be restricted to current public lands. Approval from the US Army Corps of Engineers and local jurisdictions would also be required. Increasing the frequency or magnitude of peak flow events in order to increase overbank flooding or inundate newly created or re-connected floodplains would be constrained by current operations for flood management and downstream water supply. Increasing peak flows would also require engineering design analysis and modeling to determine potential benefits and impacts.

Existing Conditions in the Proposed Resource Action Implementation Area:
The lower Feather River from Thermalito to the Sacramento confluence has been affected by many land use impacts. Historically, these included hydraulic mining, levee construction, floodplain development for agricultural and urban uses, streamflow diversions and instream construction (e.g., bridges, bank protection, etc.). The Oroville project was superimposed upon an extremely disturbed river. Since construction of the Oroville dam, the lower river has been subjected to an unnatural flow regime and reduced sediment supply. The cumulative effect of all these factors has been a significant reduction in the geomorphic and ecological functions of the river. Indicators of this include a lack of connectivity between the river and its floodplain, significant bank erosion and channel incision, substantially reduced areas of riparian forest, abundance of exotic plants in the residual riparian forest, and impaired habitat for resident and anadromous fishes.

The lower Feather River (especially below Gridley) is presently incised well below its former floodplain (10-25 feet). Studies conducted by DWR indicate that the Rosgen classification for the lower Feather River is “entrenched, F channel type.” Prior to the placement of levees, hydraulic mining, and subsequent downcutting, the lower Feather River was a meandering C channel type, comparable to the Sacramento River and other streams draining to the Central Valley. At intervals of approximately 1-2 years it would have experienced overbank flooding onto its adjacent floodplain. At the present time, only floods in excess of approximately 50,000 cfs would cause flooding out of the entrenched channel. These have occurred about a dozen times over the past 40 years. High magnitude flooding events (>100,000 cfs) have occurred three times, in 1965, 1986 and 1997.

The levee system that protects land adjacent to the river from flooding is not uniformly close to the stream. In some locations, for example, in the developed areas of the cities

of Oroville and Yuba City, levees do completely cut off the stream from its floodplain. In other locations, levees may be absent altogether from one or the other side of the river (e.g., Sutter Bypass). In most places levees are set back over 1,000 feet and agricultural usage is common within the levee boundaries.

The levee system below Thermalito is part of the Sacramento River Flood Protection Project and any proposals to modify the system would have to be approved by the US Army Corps of Engineers and overcome various institutional barriers inherent in maintaining flood protection. If this measure were properly planned and implemented, it could improve flood protection.

The physical constraints preventing the Feather River from accessing its former floodplain are the degree of incision and the currently prescribed flow regime itself that prevents flooding events of magnitudes less than the 100 year flood. Levees are a constraint only in specific places in the lower Feather River, and where they are a constraint, flood hazard considerations may be paramount.

The land ownership below Thermalito is almost exclusively private, although there is some DFG ownership around River Mile (RM) 10 to RM 11. Any proposal to increase floodplain connectivity outside of DFG land would be constrained by the willingness of landowners to either sell their land or allow the Resource Action measure on their land.

With the exception of some reaches (e.g., RM 39 to RM 54 and RM 34 to RM 35.5), within the existing channel between the levees there are relatively few floodplain surfaces. Those that exist are mostly a sandy substrate. The channel bottom itself is typically heavy clay. Consequently, there are not many suitable sites for enhancement of salmonid spawning habitat. Existing information indicates that anadromous salmonids do not typically spawn in the lower Feather River below Gridley (Brad Cavallo, personal communication).

Most existing deposits within the incised river channel are inundated by flows greater than 10,000 cfs. During the summer months flows are relatively high due to water supply releases for downstream uses. For example, under current project operations, median daily flows in August are about 6,000 cfs. It is mostly during the spring runoff season that impaired flows are lower than unimpaired flows (i.e., when the reservoir is filling). Thus, the impaired flow regime does not resemble the unimpaired regime either in timing, magnitude, or duration of peak flows.

Design Considerations and Evaluation:

Of the three potential options previously mentioned (geomorphic modifications, levee setbacks and flow management) different options or combinations of options could be used in different places to achieve the objectives of this measure. For example, under the current regulated flow regime, removing or relocating levees in most locations would not reconnect the stream to its floodplain. It would still be necessary to provide periodic flood flows. That would not be the case, however, in the Oroville Wildlife Area where

levee breaching alone would suffice to reconnect the river and its floodplain. In some other places, existing conditions may be relatively favorable for efforts to restore geomorphic and ecological functions. For example, from RM 39-54, the river still retains high sinuousity, has relatively complex geomorphology and has abundant instream woody debris. There are some existing patches of relatively intact riparian vegetation and levees are well set back from the river. It would be easier to enhance or create instream habitat and floodplain surfaces there than it would be in other locations that are severely constrained by levees. The most difficult places to implement this measure would be those that are deeply incised, severely constrained by levees, and lack geomorphic complexity. If this measure were to be implemented, it would be advisable to select places that already possess some favorable attributes.

The benefits of this measure may be difficult to assess. Some tools, such as PHABSIM, are available for evaluating changes in habitat values due to changes in flow. When both channel geometry and flow are changed, different tools are necessary. The Fluvial 12 model, which is capable of predicting some effects of geomorphic modification and levee removal, has only been calibrated for use from Thermalito to Gridley. Consequently, some other approach, such as US Army Corps of Engineers HEC models would be needed below that point. Again, if places for implementation of this measure are chosen carefully to avoid the need for extensive geomorphic modifications or levee setbacks, some uncertainties can be minimized.

Synergism and Conflicts:
Synergism is achieved by combining geomorphic modifications, levee setbacks, and flow management under one measure aimed at instream fisheries habitat improvement. This measure may conflict with current operations for flood management and water supply. It may also conflict with local landowner and agency objectives unless sites are chosen carefully to avoid conflicts.

Uncertainties:
There are many uncertainties regarding this measure. Some are related to interdependencies between actions such as geomorphic modifications and levee setbacks and requirements for a complementary flow regime. Under the current regulated flow regime, the benefits of these actions could be extremely limited. Other uncertainties pertain to the experimental nature of attempts to improve habitat. The more complex the project, the more potentially uncertain are the results. In situations where other landowners or agencies are involved, their willingness to participate may also be uncertain. The ultimate uncertainty is whether or not the measure would actually improve habitat and the productivity of the fisheries in the lower Feather River. This can only be validated through long term monitoring of fish populations.

Cost Estimate:
It is assumed that this measure will be undertaken in specific locations that will be chosen on the basis of their conditions and expected benefits. Consequently, it is not possible to provide a good estimate of costs. However, some unit costs can be

provided. For example, geomorphic surface modification would require excavation, grading and probably erosion control. Excavation and grading costs are estimated at $12/cubic yard. Erosion control would be in the range of $2,500-$8,000/acre.

Levee setbacks would require land acquisition unless confined to public land (estimated at $2,000/acre), excavation (estimated at $12/cubic yard), reconstruction of the levee (unit costs unknown) and erosion protection/revegetation ($2,500-$8,000/acre).

The costs for providing complementary flow management are equally difficult to estimate. It is assumed that this would consist of providing pulsed high flows at magnitudes capable of inundated reconnected floodplain surfaces. To be effective, these should probably be timed to mimic natural high flow events. Providing such flows would probably be at the expense of power generation or providing water supply to downstream users. Once a flow management strategy is quantified, costs for implementing it could be estimated in terms of lost power or water supply.

Recommendations:

- Further planning for this measure should consider all potential means for improving instream habitats including geomorphic modification, levee setbacks and flow management.
- A process should be developed to select the best sites for implementing this measure. Some criteria for those sites might include:
    - Existing habitat conditions are favorable for enhancement. For example, sites with existing geomorphic surfaces such as side channels and lower floodplains would be good candidates for implementation of a beneficial flow management strategy.
    - Minimal geomorphic changes would be necessary to achieve floodplain connectivity. This is related to the statement above.
    - Lands suitable for enhancement or geomorphic modification are within existing levees. All possibilities for increasing connectivity to floodplains within existing levees should be explored before considering the costly alternative of relocating levees.